



# Service Oriented Architecture

## Reference Guide





# Bottom Line Up Front

- SOA, like ERP, are complex enterprise solutions aimed at business transformation.
- It's mostly about technology management, NOT technology.
- First, clean up your enterprise data.
- Second, fine tune your business processes.
- You're putting your integrated enterprise business processes on the web, make sure they work (think Travelocity).
- It's better to start small with “chunks” than with a big bang approach.



# Introduction



**Business Transformation** is a top priority of the Secretary of the Army and the Chief of Staff, Army. It encompasses transformation of people, processes, and technology.

The success of Business Transformation will not be measured by cost savings, but instead the goal is to increase the productivity of the combat capability of the Army. In order to unlock the value of enterprise-level business processes and grow capabilities that support the warfighter, the Army must embrace change, challenge existing policy, processes and procedures, and adopt a culture of innovation and continuous, measurable improvements.

Transforming the way the Army does business is a long-term strategic imperative; it is a business problem – that is addressed with process and technology solutions.

# What is a Service-Oriented Architecture?



**Service-Oriented Architecture (SOA)** is a maturing technology that directly supports the Army vision of enterprise-level processes and services that optimize investment and build enhanced capability portfolios.

Educating leadership on the implications of business processes that will support the evolving technology environment, will help the Army achieve significant advantages from business transformation. Therefore, the purpose of this reference guide is four-fold:

- ☐ Provide a history and description of Service-Oriented Architecture,
- ☐ Explain the “how” and the “why” Service-Oriented Architecture should be used,
- ☐ Present critical success factors to be considered by decision makers, and
- ☐ Define a common language and identify standards that will drive consistency and empower decision makers.

The Enterprise Solution Competency Center (ESCC) has been established to provide the Army with an in-house capability to assist senior leadership and acquisition decision makers in the complex landscape of business transformation in three core competencies – **ERP/SOA Consultancy**, **ERP/SOA Laboratory**, and **ERP/SOA Education** services. The ESCC is staffed with government and industry experts with the overall mission to provide solutions for enterprise services.

## ESCC Key Concept:

**Army Business Transformation is about people, process, *and* technology**

# What is a Service-Oriented Architecture?



- A Service is based on a function-oriented (business process) view of an enterprise that is well-defined, self-contained, and doesn't depend on the context or state of other services.
  - ❑ A service consists of an interface and a service implementation component. The interface component facilitates interoperability and the implementation component produces results based on the application logic associated with the business process.
- A Service-Oriented Architecture (SOA) is:
  - ❑ A software design approach in which a client application requests one or more services from another application which provides complementary services.
  - ❑ A collection of services that communicate via a high-level abstraction layer and are based upon existing and emerging Web Service standards.
  - ❑ Internal or external business processes that can be combined and recombined to support flexibility in business process execution.
  - ❑ Depending on their initial state, applications that can initiate a "service request" or respond to a "service request".

## ESCC Key Concept:

- "By 2008, more than 60% of enterprises will use SOA as a guiding principle when creating mission-critical applications and processes."\*

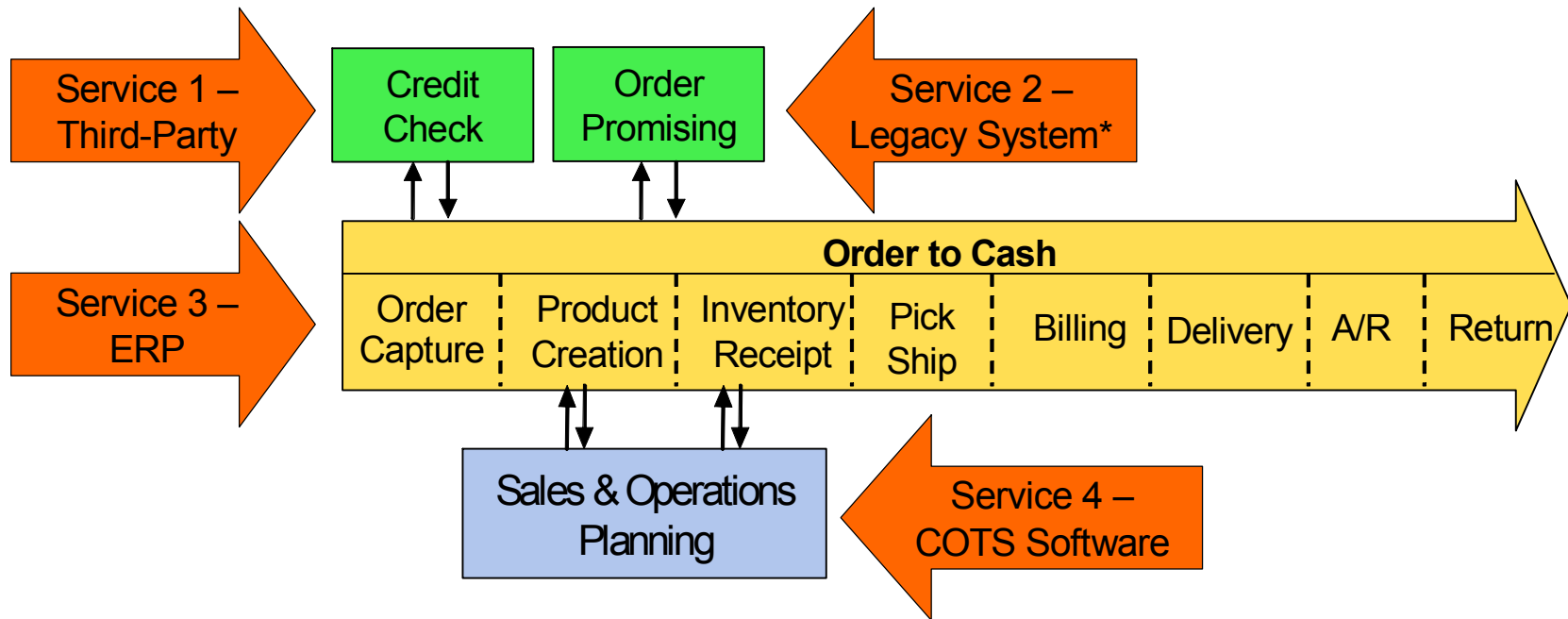
\*Source: Gartner Group

# Why Service-Oriented Architecture?



## ➤ Flexibility is the key benefit of a SOA

- ❑ If two software applications are built using SOA standards, then any business processes rendered as a collection of services can be combined to create an enterprise solution.
- ❑ *\*The legacy system must be able to interface with web services technology or additional software middleware products will be required for interoperability.*





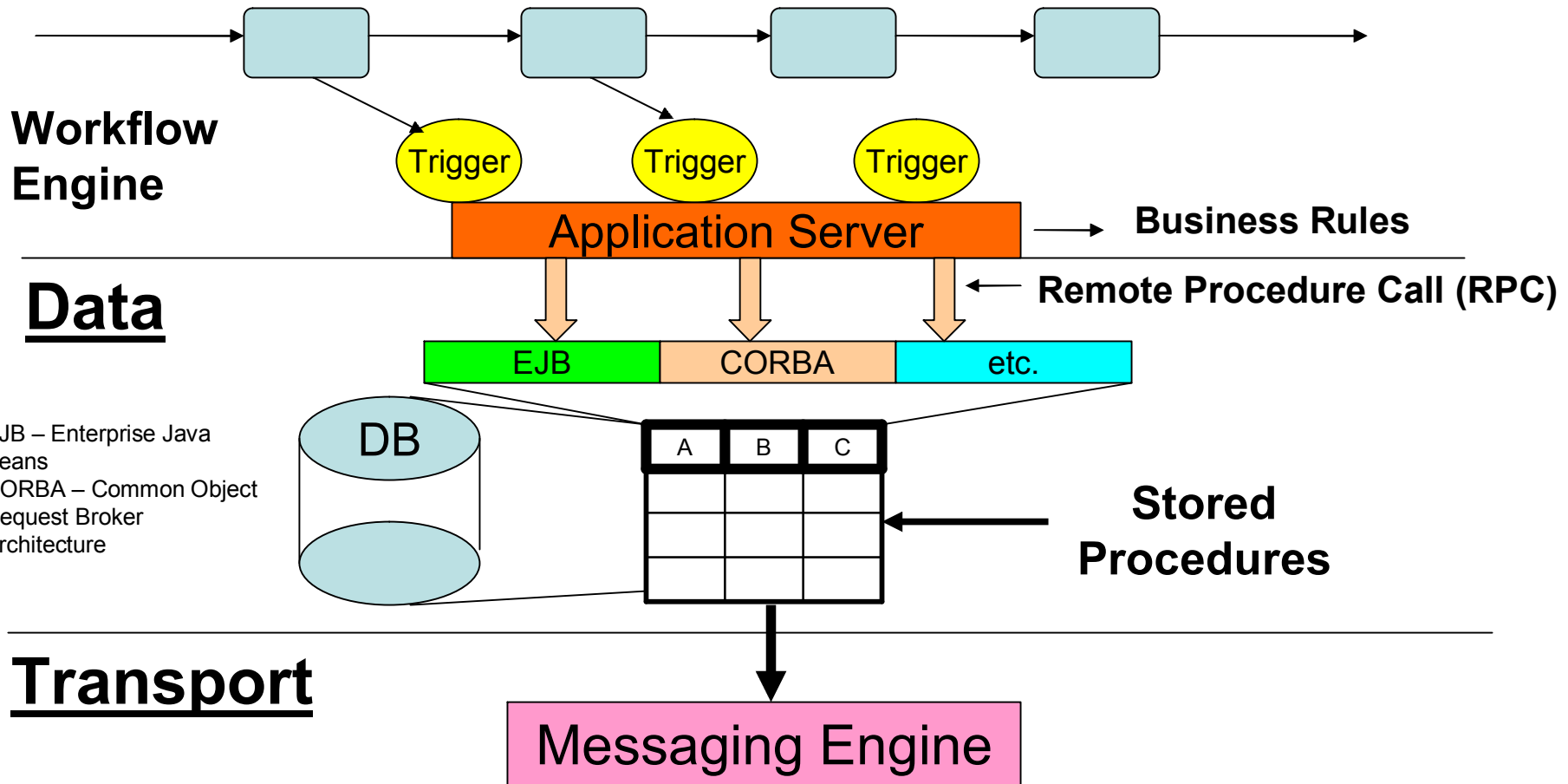
# Why Service-Oriented Architecture?

- **A Service-Oriented Architecture:**
  - ❑ Enables business transformation by providing visibility of enterprise-level business processes
  - ❑ Forces IT executives to think in terms of business process execution
  - ❑ Enables business transformation (restatement of first sub-bullet)
  - ❑ Helps emphasizes “code reuse” and thus enables a greater ROI
  - ❑ Minimizes the impact of changes to software code on other software components
- **ESCC Key Concept:** *A service-oriented architecture isn't only a technology; it's a way of doing business. It can even transform your business.\**
  - \* Christopher Lindquist, CIO Magazine, Aug 15, 2005.
- **ESCC Key Concept:** Given that SOA's are application composites, an Enterprise Architecture is much more important under this paradigm than in traditional Client/Server models.

# What is a Traditional Client Server Model?



## Process

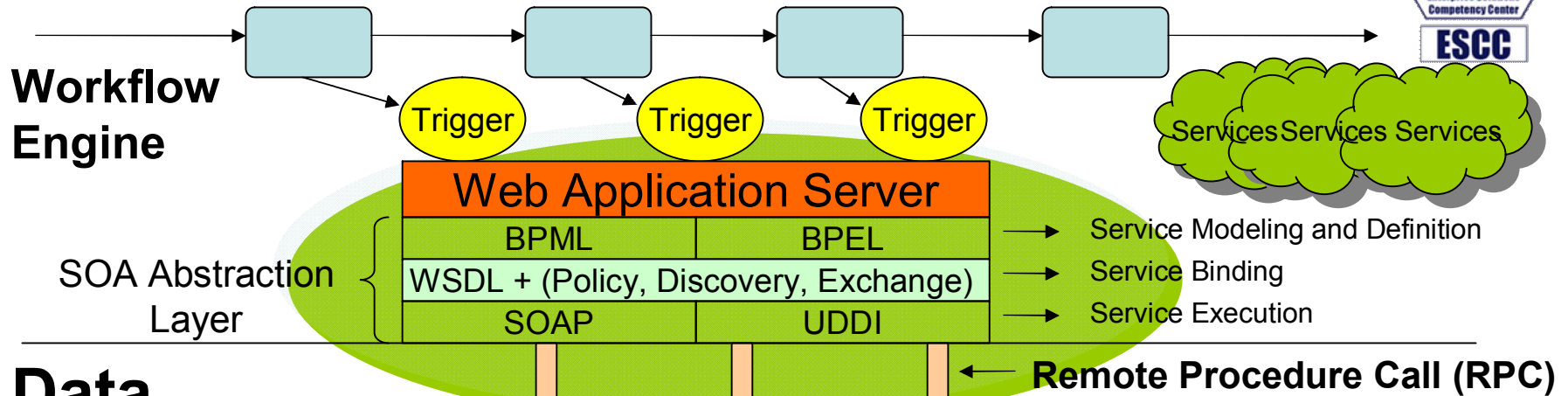




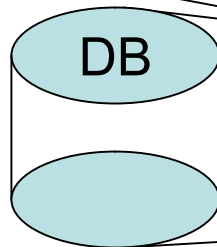
# What is a Service-Oriented Architecture?



## Process



EJB – Enterprise Java Beans  
CORBA – Common Object Request Broker Architecture



| A | B | C |
|---|---|---|
|   |   |   |
|   |   |   |
|   |   |   |

**Stored Procedures**

## Transport

**Messaging Engine**

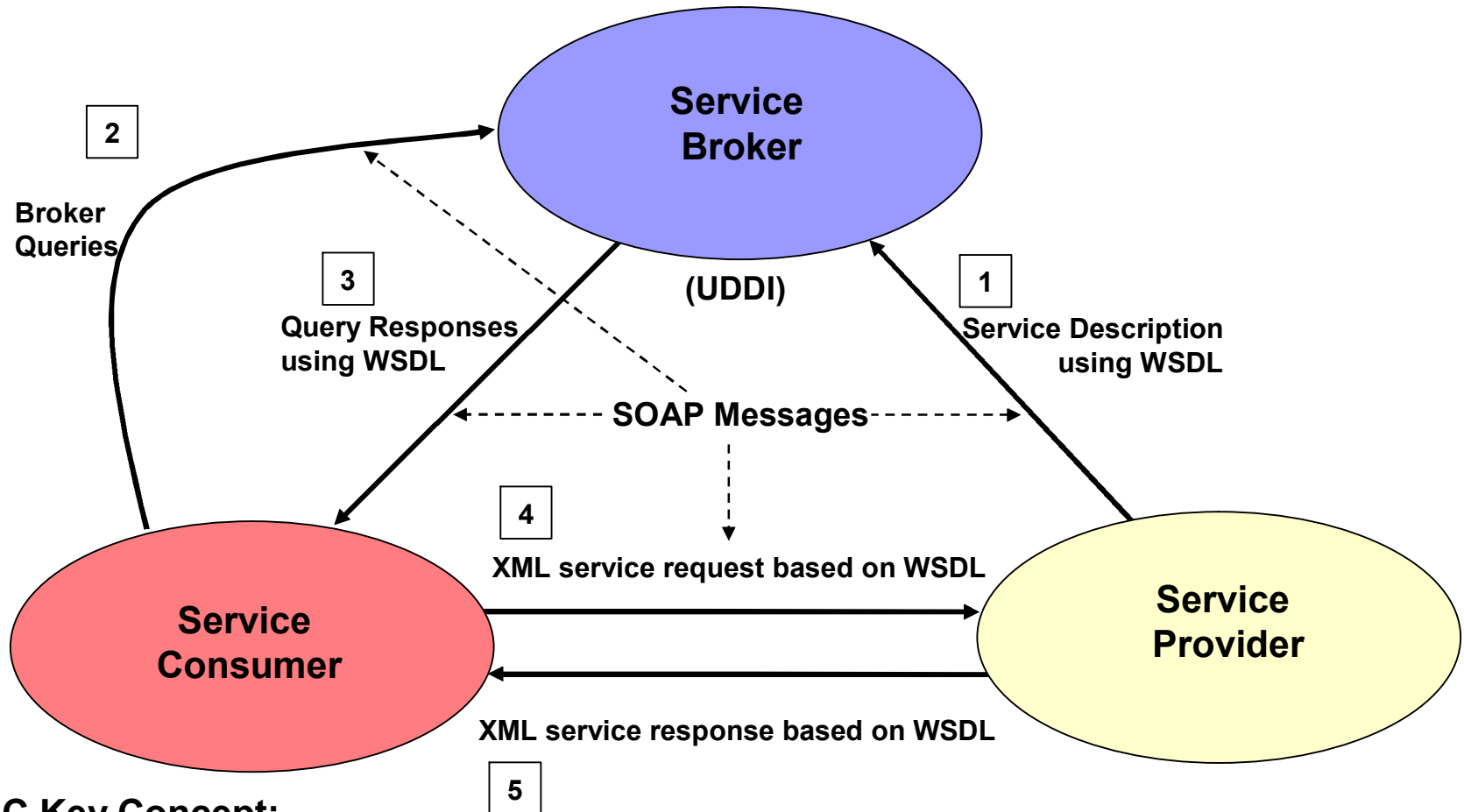
Systems

Systems

Systems



# Web Services Paradigm



## ESCC Key Concept:

- Standards are integral to web services, and web services are key to a service-oriented architecture.

# When to use SOA

- If your enterprise includes multiple stovepipes and legacy systems that have no means of communicating with each other. (If these systems happen to be based upon web services technology, then interoperability is possible without additional middleware).
- If there is no economic value in building or buying an alternative solution.
- If you want to decrease your dependency on vendor-specific software products and still use multiple software service components.
- If you are trying to maximize your ability to create flexible business processes and support cross-functional enterprise views.
- Business Processes vary, hence they need to be handled differently:
  - ☐ Transactional Processes – Not good SOA Candidates
  - ☐ Verification Processes – Good SOA Candidates
  - ☐ Management Processes – Good SOA Candidates
- **ESCC Key Concept**
  - ☐ **Use of SOA can both accelerate transformation and optimize IT investment**

# The Evolution of SOA



## ➤ 1990's:

- ❑ The World Wide Web Consortium (W3C) was founded in October 1994, largely on the initiative of Tim Berners-Lee, the so-called inventor of the Web
  - W3C continues to drive important industry standards
- ❑ Service-oriented architectures first emerged in 1996
  - Early SOAs used message broker (MOM) and traditional object-based middleware to connect web services
- ❑ Early efforts were hampered by a lack of standards (XML, object brokers, etc.) with regard to
  - Process execution,
  - Legacy system integration, and
  - Reuse of application code.

## ➤ 2000's: Evolving web services standards reduced complexity and became more economical:

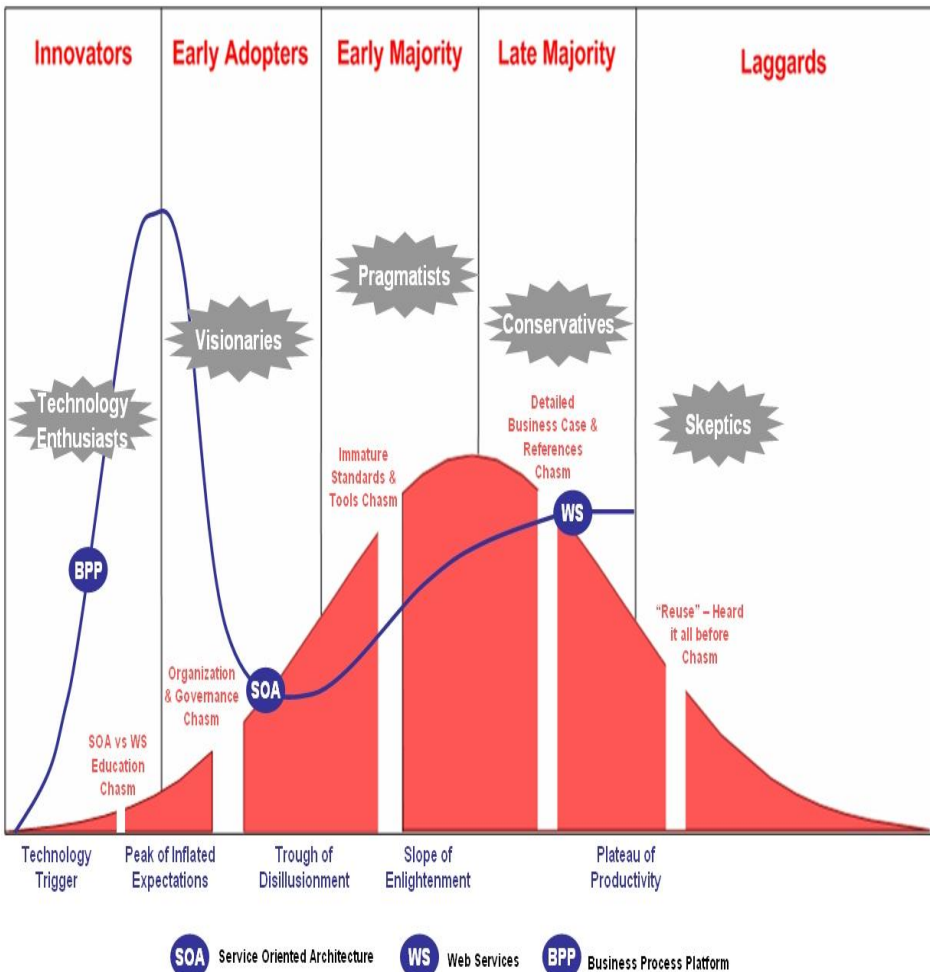
- ❑ Web Services Definition Language (WSDL) and Simple Object Access Protocol (SOAP) emerge:
  - Both use Extensible Mark-up Language (XML)
- ❑ Universal Description, Discovery and Integration (UDDI) arrives:
  - Good for reuse but not robust in the area of governance
- ❑ Emphasis in developing SOA shifts to protocols
- ❑ Today over 60 web services standards and specifications exist

## ➤ ESCC Key Concept:

- ❑ The most prominent organizations producing web service standards are: W3C, OASIS, WS-I and the Object Management Group (OMG)



# The Evolution of SOA (con't)



- The blue curve represents Gartner's "hype cycle" which graphically represents the maturity, adoption and business application of specific technologies/paradigms. Since 1995, Gartner has used hype cycles to characterize the over-enthusiasm or "hype" and subsequent disappointment that typically happens with the introduction of new technologies/paradigms.
- In July 2005 Gartner stated that the use of web services is approaching the "Plateau of Productivity". This can be attributed to some key web services standards being published and being made available in a plethora of tools and products.
- Gartner states that SOA is approaching the "Trough of Disillusionment". It has taken a while for SOA to reach this state and feels as though SOA has been hyped beyond past new technologies/paradigms.

## ESCC Key Concept

- With SOA approaching the "Trough of Disillusionment", the focus will now move away from the marketing aspects and onto the real delivery of SOA. (Mr. Steve Bennett, BEA)





# Current State of SOA

- Three web services standards form the foundation of SOA development:
  - ❑ SOAP – An XML-based specification for defining how Web services exchange messages.
  - ❑ WSDL – An XML-based taxonomy for defining the characteristics and functionality of a web service.
  - ❑ UDDI – Provides a central repository which lists web services that are available, akin to an address book.
- These standards continue to mature and have been used inconsistently by vendors.
- The DoD continues to review these standards due to security and authorization deficiencies which are currently inconsistent with GIG requirements.



# SOA Standards in the DoD

**DISR:** Department of Defense Information Technology Standards Registry. DISR contains all of the approved and active technical standards to be used by DoD components. It replaces the Joint Technical Architecture (JTA).

➤ Standards have 1 of 3 states:

- ☐ Emerging
- ☐ Mandated
- ☐ Inactive/Retired

➤ Some commercial SOA standards have not been included in the DISR.

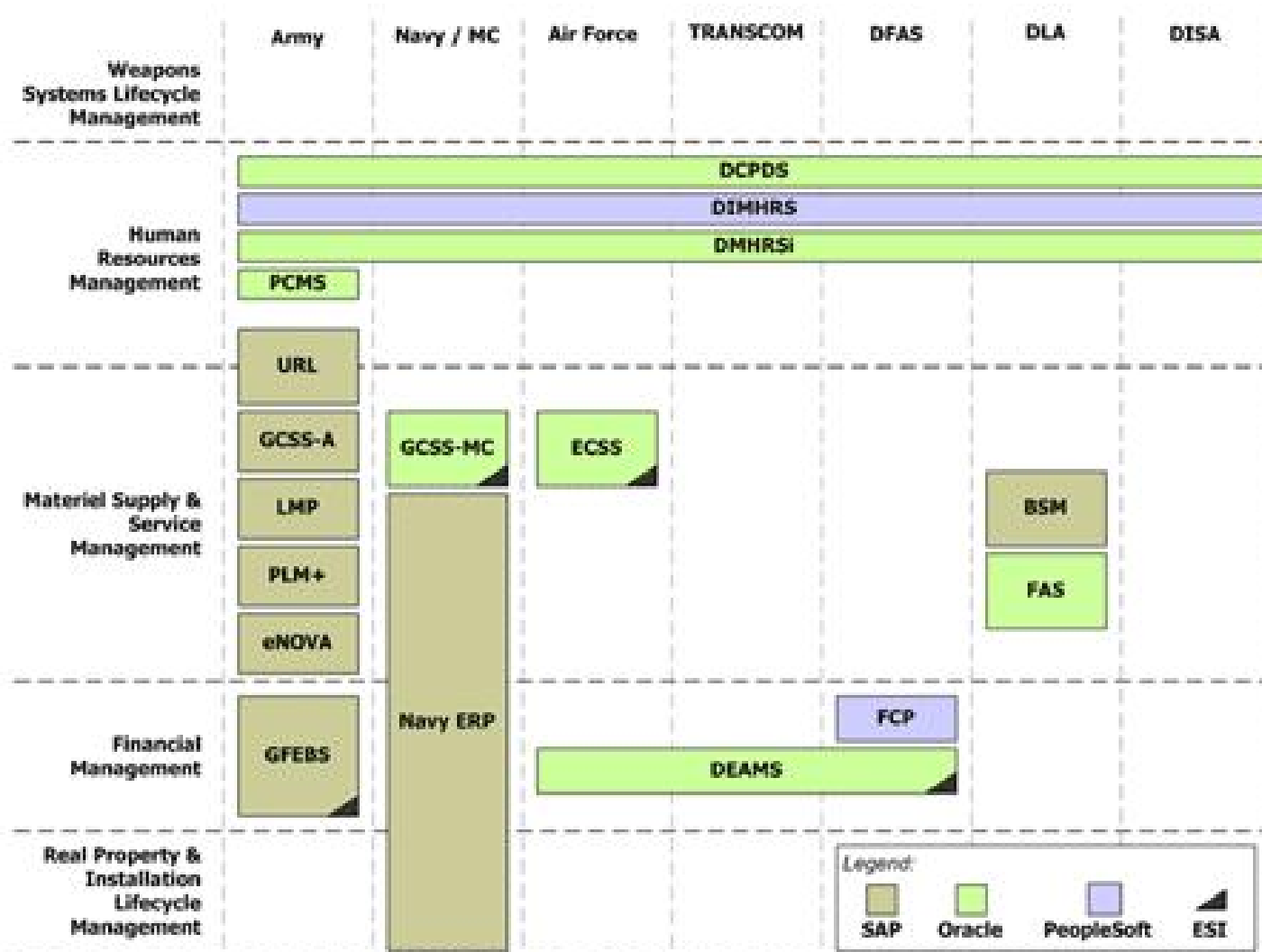
- ☐ If project teams require the use of SOA standards not yet in the DISR, a waiver must be obtained from DISR to implement new standards.

| Standard  | DISR Status |
|-----------|-------------|
| SOAP      | Mandated    |
| WSDL      | Mandated    |
| UDDI      | Mandated    |
| WSS_Core  | Mandated    |
| WSRP      | Mandated    |
| JSR168    | Mandated    |
| WebDav    | Mandated    |
| WS-BPEL   | None        |
| WS-Policy | None        |



# SOA and the Army

Major ERP programs are the top candidates for the use of SOA





# Top 10 Reasons SOA Implementations Fail



1. **Governance** – No single person in charge who reports directly to senior executives.\*
2. **Scope** – The implementation contract doesn't align with a SOA-based enterprise solution, but instead is aligned with programs, systems, or other non-enterprise artifacts.
3. **Change Management** – Insufficient investment in CM activities, -- the people side of change.\*
4. **Skills** – Implementation team doesn't have a thorough understanding of SOA concepts and the required enabling enterprise technologies.\*
5. **Decision Making** – Consensus decision making as opposed to rapid decision making.\*
6. **Communication** – Lack of communication at all levels.\*
7. **Solution Architecture** – No SOA-based solution architecture and appropriate implementation methodology.
8. **Training** – Insufficient investment in project team and user training and executive education.\*
9. **Culture** – Trying to force the enterprise software into a stovepiped culture.\*
10. **Leadership** – Lack of project continuity because of leadership.\*

## ESCC Key Concept:

- **\*Technology does not deliver transformation – people do. Successful “Army Business Transformation” requires strong, dedicated Army leadership.**

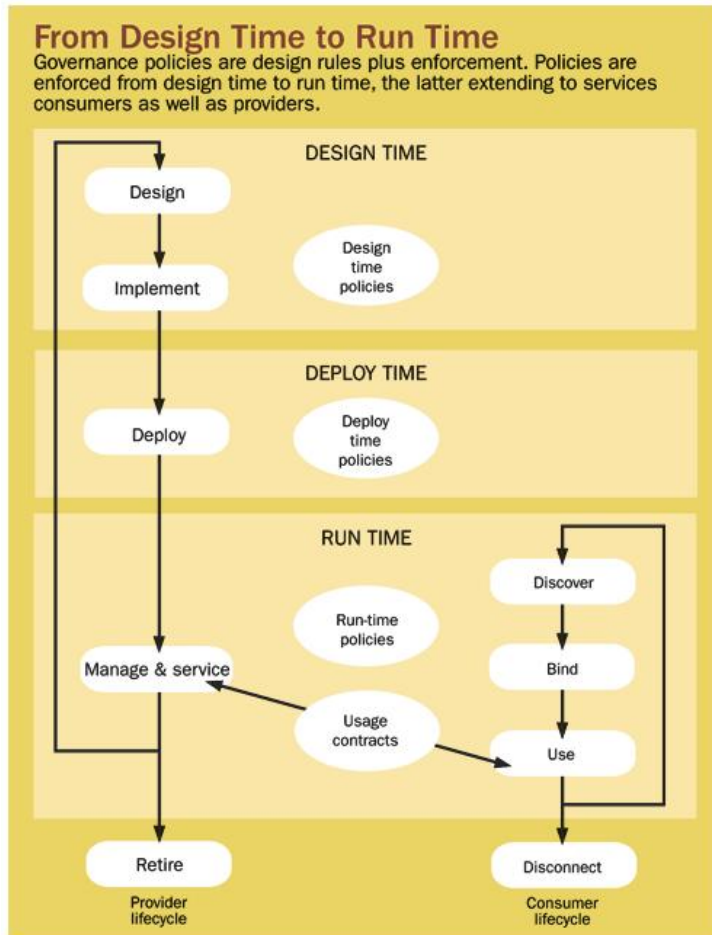
# Important Questions to Ask



- Do you have a governance structure?
- Are the business and IT executives aligned and are they communicating?
- Have you identified the correct services to include in a SOA strategy?
- Have you identified the business processes being supported?
- Have you selected the correct systems to align?
- Have you budgeted for the entire scope of the project, through post-implementation and sustainment?
- Do you have the necessary skills to plan and operationalize a SOA?
- Have you defined the end state?



# SOA Governance



\* Phillip J. Windley, InfoWorld, January 19, 2006.

- \* Governance and architecture go hand in hand. In the same way that building codes, standards, and even inspections give building architects a context within which to work and ensure that their designs will fit in the community, SOA governance provides context for system architects and designers.

## ESCC Key Concept

- **SOA governance gives consistency, predictability, and allows big apps to be built from small pieces.**

(Mr. Roman Stanek, Systinet)





# Implementation Approach

- Top - Down
  - ❑ Establish the Vision - Build the Architecture
    - Ensure compliance with the Army Net Centric Operations and Warfare (ANCOW) Technical Reference Model (TRM)
    - Shape the acquisition and delivery of future business capabilities
    - Develop capability-based portfolios and key investment strategies
    - Establish technical framework for legacy and system evolution

## ESCC Key Concept

- System communication involves:
  - ❑ simple data passing, or
  - ❑ two or more services coordinating some activity, and
  - ❑ some means of connecting services to each other.



# Implementation Approach

## ➤ **Bottom - Up**

- ❑ Implement “Quick Start” near-term Horizontal Integration Initiatives (HII)
  - Provide “short money” for programs to execute
  - Focus on NCOW technology ready for transition to operational use
- ❑ Evolve capabilities as a force package that include back office reach back
  - 2 year Block upgrade structure for a loose collection of “family of systems” - HIIs and program execution
  - Operational Assessment based on Integration and Interoperability.

## **ESCC Key Concept**

- **Start small with quick hits, then add scope and resources as the SOA matures**



# Critical Success Factors

## Change Management - Project champion:

- There must be a high-level executive sponsor who has the power to set goals and legitimize change
- The Project sponsor's leadership and commitment are critical to drive consensus across the full implementation lifecycle
- The leader must continually strive to resolve conflicts and manage resistance.
- A single Enterprise Process Owner should be in charge so there is a whole business (enterprise-wide) perspective



# Critical Success Factors



## Continuous Process Improvement (CPI):

- SOA enhances service delivery through improved enterprise business processes
- Business and IT executives need to routinely communicate to be effective
- IT executives need to learn to think in terms of business processes (instead of stand-alone applications)
- IT executives need to embrace the role of Transformation Enabler
- Keep people focused on the SOA goals





# Critical Success Factors

## Performance Measurement –

- Build a vision (of the end state) and plan for specific, measurable, scope and realistic expectations
- Define a clear vision of how the organization will meet strategic goals for the business processes in question
  - ❑ Share the vision
- Make sure executives have a good understanding of the problems and opportunities involved in transformation
- Have a clear business transformation plan to direct the project through its lifecycle and measure incremental progress toward goals
- Identify and track the benefits and costs
- The project objectives should be directly related to overall business transformation
- Decide on the level of service to provide and keep it high level
  - ❑ Too granular = more required services
  - ❑ More required services = bigger investment

## ➤ **ESCC Key Concept**

A well-defined governance structure is “the key” to success.



# Critical Success Factors



## Define the end state:

- A Solution architecture that defines the end-state, and the ability to manage/monitor to the end-state are critical to success
- An appropriate public-sector methodology must be used
  - ☐ Methodologies that were designed for managing weapon system development are not appropriate for managing organizational transformation
- **ESCC Key Concept**
  - ☐ **System acquisition shouldn't be considered until the end-state has been adequately defined.**



# Critical Success Factors

## Budget For a Successful Project

- Reengineering and building a service-oriented architecture will be expensive.
- A very disciplined Enterprise Architecture-based approach will drive success.
  - ❑ Expect to:
    - Invest in change management activities
    - Investigate business processes:
      - Reevaluate
      - Redefine
      - Reverse engineer
    - Invest in technology

## ESCC Key Concept

**SOA requires a long-term investment, but will eventually increase agility. Short-term goals may need to be sacrificed for long-term objectives. Therefore, design your strategy so that you can keep change going past short-term obstacles.**



# Mitigating Strategies

## Federated Architecture:

- Provides an enterprise-wide perspective
- Aligns independent architectures together using a proven federated methodology
- Allows for flexible, heterogeneous architecture development

## Process Performance Measurements and Reporting:

- Service-oriented architectures require complex monitoring and auditing requirements
  - ❑ Ability to monitor legacy systems relative to SOA environment
- Executive dashboard views with robust reporting capabilities
- Measure against project goals
- Monitor against milestones and targets





# Mitigating Strategies

## Friendly Firewalls:

- Be aware that not all partners aligning with your SOA will have an adequate messaging backbone that is reliable or secure
- Not all messaging protocols are firewall friendly

## Shared Security:

- Your SOA should allow for encryption of messaging and for decryption when received
- Partners aligning with your SOA should share the same security protocols.





# Mitigating Strategies

## Realistic Approach:

- Be aware of the impact of immature technology in the Web services area
- Use near-real time systems versus real time systems
  - ❑ Choose systems that won't have a large negative impact on the enterprise if SOA fails
- Use SOA where it makes sense
  - ❑ The use of too many services can disable your network





# Definitions and Standards

**Business Process:** A business process is a sequence of functions that are executed by organizational units, according to appropriate process logic, using the necessary data. This ensures that an overriding task (relating to certain objects) is completely carried out (Kirchmer, 1998).



# Definitions and Standards



## Business Process Architecture

A Business Process Architecture is a hierarchically decomposable documentation of the totality of the business processes that are planned or implemented to enable an enterprise. The architecture is usually documented using a particular modeling methodology and is stored in an object linked repository. Architectures usually contain other views in addition to the business process view.



# Definitions and Standards



## Cross-Functional Business Process

A business process that spans organizational domains is called a Cross-Functional Process. These domains could be defined by an organizational chart; e.g., sales, production, shipping, etc. They could also be defined by the informal organization; e.g., political or budgetary boundaries.

## Enterprise Architecture Planning

Enterprise Architecture Planning is the process of defining and documenting a plan (i.e., a blueprint) for the use of information in support of the business processes of an organization. Enterprise Architecture Planning also includes the plan for implementing against the requirements as documented in the architecture. Enterprise Architectural Planning is a business responsibility and it is executed by line personnel within the organization. Technologists play a supporting role, but they should never be given the task of developing an enterprise architecture.





# Definitions and Standards



## Enterprise Application Integration

Enterprise Application Integration (EAI) is the sharing of data and business process logic across hetero/homogeneous instances through message-oriented-middleware (MOM). EAI may be managed by packaged vendors [SAP ALE or Oracle OAI] or through solutions provided by 3rd party vendors (e.g., IBM, WebMethods, etc.). EAI is sometimes called Application-Centric Interfacing.

## Enterprise Integration

Enterprise Integration is the vertical and horizontal alignment of plans, business processes, and information systems across organizational and functional boundaries to provide competitive advantage. The process of achieving Enterprise Integration includes all managerial and technological factors that enable Cross-Functional Process Integration. The result is a customer oriented management structure with information systems that are formally linked to processes and the integration of processes needed to establish/retain customer satisfaction.



# Definitions and Standards



## Enterprise Resource Planning (ERP)

ERP is the popular name in the USA for Standard Software Solutions. ERP provides modularly integrated business applications across the enterprise. ERP systems have their origins from two sources: Manufacturing Resource Planning systems and Financial Accounting systems. MRP software provides added human resource, financial, and other functionality to evolve into an ERP system. An example of this type of Standard Software Solution is Baan V. Financial Accounting solution providers added human resource, manufacturing, and other functionality to evolve to an ERP system. An example of this type of Standard Software Solution is Great Plains eEnterprise.





# Definitions and Standards

**Service:** A service is a function (business process) that is well-defined, self-contained, and doesn't depend on the context or state of other services.

## **Simple Object Access Protocol (SOAP) - Mandated DISR standard**

SOAP provides HTTP/SML-based remote procedure call capability for XML Web Services. It is used for exchanging structured and typed information between peers in a decentralized, distributed environment. SOAP is a one-way communication and it is comparable to the current use of Remote Procedure Call (RPC). SOAP can be used in combination with other protocols. Its full development in Web services has to be integrated with UDDI and WSDL. SOAP itself has no message semantics. Sender and receiver must agree on meanings of both header and body elements. It also requires application agreement on allowable or desirable sequences of messages.

The SOAP protocol is still evolving. There are significant security issues that need to be considered which are inadequate for the DoD GIG.



# Definitions and Standards



## **Web Services Business Process Execution Language (WSBPEL):**

WS-BPEL, also known as Business Process Execution Language for Web Services (BPEL4WS), provides a language for the formal specification of business processes and business interaction protocols. By doing so, it extends the Web Services interaction model and enables it to support business transactions. WS-BPEL defines an interoperable integration model that should facilitate the expansion of automated process integration in both the intra-corporate and the business-to-business spaces.





# Definitions and Standards

## **Web Services Description Language (WSDL) - Mandated DISR standard**

WSDL is an XML-based interface description language to describe XML Web Services and how to use them. WSDL describes the syntax and location of web services. WSDL definitions are “semantic-free”; the operations of web services are defined in terms of sequences of messages to be exchanged and with whom. This standard is still at an early stage of development.

## **Extensible Markup Language (XML) - Mandated DISR standard**

Extensible Markup Language (XML) is a simple, very flexible text format derived from Standard Generalized Markup Language (SGML). XML is used as a common data format at all levels of web services architectures. It uses Document Type Definitions (DTDs) to describe tags which define the data to be exchanged. It is useful for hierarchical structuring of data.

## **ESCC Key Concept:**

- **A successful SOA requires long-term commitment from business and IT executives within an enterprise.**

## Slide 37

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**BWH15** Is this ESCC Key Concept really appropriate for this slide. I suggest it could belong on Slide 18 - Critical Success Factors - Change Management - Project Champion  
bowie.w.hinger, 3/29/2006



# Definitions and Standards

**WS-Policy:** Web services policy. A *specification* that handles policies around SOAP-based web services, including but not limited to security policies. Not yet a standard.

## **Universal Description, Discovery and Integration (UDDI) - Mandated DISR standard**

UDDI is used for publishing and discovery of web services. UDDI provides a searchable registry of XML Web Services and their associated URLs and WSDL pages. The goal is to enhance interoperability and speed adoption for web services. It consists of standard-based specifications for service description and discovery, and a shared business registry on the web. Essentially it is a large directory of available services, and is intended for business to business application usage. UDDI standardization requires vendor acceptance and synchronization with SOAP and WSDL activities.

Note: The UDDI standard is still evolving. As with SOAP and WSDL, there are significant security issues that need to be considered. UDDI, SOAP and WSDL are not adequate for the DoD GIG because they do not currently include the necessary security and authorization information.

## **ESCC Key Concept**

**Approach proprietary 'black box' XML with caution**





# Definitions and Standards

## **Web Services Security Core (WSS\_Core) - Mandated DISR standard**

WSS-Core provides mechanisms to send a security token as part of a message to ensure message integrity and message confidentiality. WSS-Core is a fundamental component for a Web Services security solution, provides a foundation for a complete security solution for web services, and enables applications to construct secure SOAP message exchanges.

This standard is completed and being implemented by vendors, however the higher-level capabilities are still immature, in conflict, or non-existent.

## **Web Services for Remote Portals (WSRP) - Mandated DISR standard**

WSRP is a specification which defines how to leverage SOAP-based Web services that generate mark-up fragments within a portal application. By defining a set of common interfaces, WSRP allows portals to display remotely-running portlets inside their pages without requiring any additional programming by the portal developers.

ERP vendors are slowly adopting this standard. Adherence to this standard should be probed during a software selection process.

## **ESCC Key Concept**

**Security must be vetted jointly at the network, operating system, database, messaging system, and application server layers.**





# Definitions and Standards

## **Java Specification Request (JSR) 168 - Mandated DISR standard**

JSR 168 defines a Portlet API that provides the means for aggregating several content sources' and applications' front ends. It also addresses how the security and personalization is handled. Portlets are web components - like Servlets\_ - specifically designed to be aggregated in the context of a composite page. Usually, many Portlets are invoked in the single request of a Portal page. Each Portlet produces a fragment of markup that is combined with the markup of other Portlets, all within the Portal page markup.

## **Web Distributed Authoring and Versioning (WebDav) – Mandated DISR standard**

The Web Distributed Authoring and Versioning protocol improves the efficiency of common remote editing operations, provides a locking mechanism to prevent overwrite conflicts, improves link management support between non-HTML data types, provides a simple attribute-value metadata facility, provides for the creation and reading of container data types, and integrates versioning into the WWW. This standard is still evolving.





# Summary

- SOA is maturing
- You are putting your business processes on the Web as a service
- Requires a lot of up-front hard work
- Bad data will always be the giant-killer
- The key to success is technology management
- There are other alternatives





# Useful Web Sites

<http://www.army.mil/escc/>

Visit the ESCC

<https://aakc.army.mil>

Army architectures

<http://www.xml.org>

information about the application of XML in industrial and commercial settings

<http://www.oasis-open.org/home/index.php>

Global consortium that drives the development, convergence, and adoption of e-business standards

<http://www.w3.org/>

Global consortium that develops web services interoperable technologies, specifications, guidelines, software, and tools

<http://www.ws-i.org/>

Open industry organization chartered to promote Web services interoperability across platforms, operating systems and programming languages

<http://www.omg.org/>

Global consortium that promotes the theory and practice of object-oriented technology in software development

<http://www.cio.com>

Executive level publication

<http://www.commentwire.com>

Computer Business Review

<http://www.networkworld.com>

Network IT Information

[http://en.wikipedia.org/wiki/Service-oriented\\_architecture#SOA\\_design\\_and\\_development](http://en.wikipedia.org/wiki/Service-oriented_architecture#SOA_design_and_development)

Wikipedia, the free encyclopedia



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